CLAIMS:

1. An optical information recording medium having a multilayer structure comprising at least a lower protective layer, a phase-change type optical recording layer, an upper protective layer and a reflective layer, on a substrate, wherein the phase-change type optical recording layer has a composition of $Zn_{\gamma 1}In_{\delta 1}Sb_{\zeta 1}Te_{\omega 1}$, where $0.01 \leq \gamma 1 \leq 0.1$, $0.03 \leq \delta 1 \leq 0.08$, $0.5 \leq \zeta 1 \leq 0.7$, $0.25 \leq \omega 1 \leq 0.4$, and $\gamma 1+\delta 1+\zeta 1+\omega 1=1$, whereby overwrite recording is carried out by modulation of light intensity of at least strong and weak two levels, so that a crystalline state is an unrecorded state, and an amorphous state is a recorded state.

2. An optical information recording medium having a multilayer structure comprising at least a lower protective layer, a phase-change type optical recording layer, an upper protective layer and a reflective layer, on a substrate, wherein the phase-change type optical recording layer has a composition of $Zn_{\gamma 2}In_{\delta 2}Ma_{\varepsilon 2}Sb_{\zeta 2}Te_{\omega 2}$, where Ma is at lest one member selected from Sn, Ge, Si and Pb, $0.01 \leq \gamma 2 \leq 0.1$, $0.001 \leq \delta 2 \leq 0.1$, $0.01 \leq \varepsilon 2 \leq 0.1$, $0.5 \leq \zeta 2 \leq 0.7$, $0.25 \leq \omega 2 \leq 0.4$, $0.03 \leq \delta 2+\varepsilon 2 \leq 0.15$, and $\gamma 2+\delta 2+\varepsilon 2+\zeta 2+\omega 2=1$, whereby overwrite recording is carried [illegible] modulation of light intensity of at least strong

unrecorded state, and an amorphous [illegible] state.

3. The optical information recording medium according to Claim 2, wherein said Ma is Ge.

4. The optical information recording medium according to Claim 1 or 2, wherein the phase-change type optical recording layer has a thickness of from 15 to 30 nm, the upper protective layer has a thickness of from 10 to 50 nm, and the reflective layer has a thickness of from 50 to 500 nm and is made of a metal containing at least 90 atomic % of Au, Ag or $A\ell$ and having a volume resistivity of from 20 to 300 $n\Omega \cdot m$.

5. An optical information recording medium having a multilayer structure comprising at least a lower protective layer, a phase-change type optical recording layer, an upper protective layer and a reflective layer, on a substrate, for overwrite recording by modulation of light intensity of at least two levels, so that a crystalline state is an unrecorded state, and an amorphous state is a recorded state, wherein the phase-change type optical recording layer has a composition of $Mb_zGe_y(Sb_xTe_{1-x})_{1-y-z}$, where Mb is at least one member selected from Ag and Zn, $0.60 \leq x \leq 0.85$, $0.01 \leq y \leq 0.20$, and $0.01 \leq z \leq 0.15$.

6. The optical information recording medium according to Claim 5, wherein $0.65 \leq x \leq 0.80$, $0.01 \leq y \leq 0.15$, and

The optical information recording medium according to Claim 5, wherein the phase-change type optical recording

layer has a thickness of from 15 to 30 nm, the upper protective layer has a thickness of from 10 to 50 nm, and the reflective layer has a thickness of from 50 to 500 nm and is made of a metal containing at least 90 atomic % of Au, Ag or Aℓ.

8. The optical information recording medium according to Claim 5, wherein the lower protective layer has a thickness of from 50 to 500 nm, of which a portion of from 1 to 10 nm on the side contacting the recording layer, is made of a mixture comprising a chalcogen compound and a heat resistant compound having a decomposition temperature or melting point of at least 1,000°C which is not a chalcogen compound, and the rest is made of a heat resistant compound of a different or same type as said heat resistant compound.

9. The optical information recording medium according to Claim 1, 2 or 5, wherein to carry out an initialization operation by irradiating an energy beam for crystallization, after forming the phase-change type optical recording layer, the recording layer is locally melted and crystallized during resolidification.

10. The optical information recording medium according to Claim 1, 2 or 5, which is a recording medium whereby mark length modulation recording and erasing are carried out

capable of recrystallizing amorphous mark portions is

applied, and to form mark portions having a length nT where T is a clock period and n is an integer of at least 2, writing power Pw and bias power Pb are applied in such a manner that when the time for applying writing power Pw is represented by $\alpha_1 T$, $\alpha_2 T$, ..., $\alpha_m T$, and the time for applying bias power Pb is represented by $\beta_1 T$, $\beta_2 T$, ..., $\beta_m T$, the laser application period is divided into m pulses in a sequence of $\alpha_1 T$, $\beta_1 T$, $\alpha_2 T$, $\beta_2 T$, ..., $\alpha_m T$, $\beta_m T$, to satisfy the following formulae:

when $2 \leq i \leq m-1$, $\alpha_i \leq \beta_i$;

$m=n-k$, where k is an integer of $0 \leq k \leq 2$, provided that $n_{min}-k \geq 1$, where n_{min} is the minimum value of n; and

$\alpha_1+\beta_1+ \ldots +\alpha_m+\beta_m = n-j$, where j is a real number of $0 \leq j \leq 2$;

and under such conditions that $Pw>Pe$, and $0<Pb \leq 0.5Pe$, provided that when $i=m$, $0<Pb \leq Pe$.

11. The optical information recording medium according to Claim 10, wherein $0<Pb \leq 0.2Pe$, provided that when i is m, $0<Pb \leq Pe$, and when $2 \leq i \leq m-1$, $\alpha_i+\beta_i=1.0$, and $0.05<\alpha_i \leq 0.5$.

12. An optical recording method, which comprises carrying out mark length modulation recording and erasing on the optical information recording medium as defined in Claim 1, 2 or 5 by modulating a laser power among at least 3 power levels, wherein to form inter-mark portions,

mark portions is applied, and to form mark portions

having a length nT where T is a clock period and n is an

integer of at least 2, writing power Pw and bias power Pb are applied in such a manner that when the time for applying writing power Pw is represented by $\alpha_1 T$, $\alpha_2 T$, ..., $\alpha_m T$, and the time for applying bias power Pb is represented by $\beta_1 T$, $\beta_2 T$, ..., $\beta_m T$, the laser application period is divided into m pulses in a sequence of $\alpha_1 T$, $\beta_1 T$, $\alpha_2 T$, $\beta_2 T$, ..., $\alpha_m T$, $\beta_m T$, to satisfy the following formulae:

when $2 \leq i \leq m-1$, $\alpha_i \leq \beta_i$;

$m=n-k$, where k is an integer of $0 \leq k \leq 2$, provided that $n_{min}-k \geq 1$, where n_{min} is the minimum value of n; and

$\alpha_1+\beta_1+ \ldots +\alpha_m+\beta_m = n-j$, where j is a real number of $0 \leq j \leq 2$;

and under such conditions that Pw>Pe, and $0<Pb \leq 0.5Pe$, provided that when i=m, $0<Pb \leq Pe$.

13. The optical recording method according to Claim 12, wherein $0<Pb \leq 0.2Pe$, provided that when i is m, $0<Pb \leq Pe$, and when $2 \leq i \leq m-1$, $\alpha_i+\beta_i=1.0$, and $0.05<\alpha_i \leq 0.5$.

14. An optical information recording medium having a multilayer structure comprising at least a lower protective layer, a phase-change type optical recording layer, an upper protective layer and a reflective layer, on a substrate, wherein the phase-change type optical recording layer has a composition of $Ge_f(Sb_dTe_{1-d})_{1-f}$,

from 15 to 30 nm, the protective layer has a thickness from 10 to 50 nm, and the reflective layer is made of a

metal containing at least 90 atomic % of Au, Ag or Aℓ and has a thickness of from 50 to 500 nm, whereby mark length modulation recording and erasing are carried out by modulating a laser power among at least 3 power levels at a linear velocity of from 1 to 7 m/s, wherein to form inter-mark portions, erasing power Pe capable of recrystallizing amorphous mark portions with irradiation for less than 100 nanoseconds is applied, and to form mark portions having a length nT where T is a clock period and n is an integer of at least 2, writing power Pw and bias power Pb are applied in such a manner that when the time for applying writing power Pw is represented by $\alpha_1 T$, $\alpha_2 T$, ..., $\alpha_m T$, and the time for applying bias power Pb is represented by $\beta_1 T$, $\beta_2 T$, ..., $\beta_m T$, the laser application period is divided into m pulses in a sequence of $\alpha_1 T$, $\beta_1 T$, $\alpha_2 T$, $\beta_2 T$, ..., $\alpha_m T$, $\beta_m T$, to satisfy the following formulae:

when $2 \leq i \leq m-1$, $\alpha_i \leq \beta_i$;

$m=n-k$, where k is an integer of $0 \leq k \leq 2$, provided that $n_{min}-k \geq 1$, where n_{min} is the minimum value of n; and

$\alpha_1+\beta_1+ \ldots +\alpha_m+\beta_m = n-j$, where j is a real number of $0 \leq j \leq 2$;

and under such conditions that Pw>Pe, and $0<Pb \leq 0.5Pe$, [illegible] that when $i=m$, $0<Pb<Pe$.

Claim 14, wherein the upper protective layer has a thickness of from 10 nm to 30 nm.

16. The optical information recording medium according to Claim 14, wherein $0.65 \leq d \leq 0.75$, and $0.02 \leq f \leq 0.15$, and recording is carried out at a linear velocity of from 2 to 7 m/s.

17. The optical information recording medium according to Claim 14, wherein to carry out an initialization operation by irradiating an energy beam for crystallization, after forming the phase-change type optical recording layer, the recording layer is locally melted and crystallized during resolidification.

18. The optical information recording medium according to Claim 14, wherein a crystallization accelerating layer which is per se crystalline during deposition, is formed between the phase-change type optical recording layer and the lower protective layer in a thickness of from 0.2 to 10 nm, and an initialization operation is carried out by irradiating an energy beam to the recording layer for crystallization.

19. The optical information recording medium according to Claim 18, wherein the crystallization accelerating layer is made of Sb_aTe_{1-a}, where $0.3 \leq a \leq 0.5$.

20. The optical information recording medium according to Claim 18, wherein a composition-adjusting layer is formed adjacent to the crystallization accelerating layer, so

[illegible]

accelerating layer is close to the composition of the

recording layer.

21. The optical information recording medium according to Claim 14, wherein the lower protective layer has a thickness of from 50 to 500 nm, of which a portion of from 1 to 10 nm on the side contacting the recording layer, is made of a mixture comprising a chalcogen compound and a heat resistant compound having a decomposition temperature or melting point of at least 1,000°C which is not a chalcogen compound, and the rest is made of a heat resistant compound of a different or same type as said heat resistant compound.